



The University of Georgia

*University of Georgia
Faculty of Engineering Outreach Service*

*Dalton Utilities' Industrial Users
PFC Wastewater Sampling Project*

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Dalton Utilities

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Introduction

Dalton Utilities requested the assistance of the Sustainability Division of the Department of Natural Resources (DNR) in the current extensive wastewater sampling survey of Dalton Utilities industrial users to determine any potential sources of Perflourooctanoic acid (PFOA) and Perflourooctane sulfonate (PFOS) and various forms thereof within the Dalton Utilities wastewater service area. In an effort to ensure an unbiased survey, DNR requested the assistance of the Faculty of Engineering Outreach Service at The University of Georgia (UGA) to conduct an impartial third party sampling of all permitted Industrial Users (IU) under Dalton Utilities' pretreatment program. All sampling activities and associated activities were conducted by UGA personnel.

Materials and methods

Equipment and Facilities

All transportation vehicles, the UGA Engineering Outreach Service Mobile Laboratory trailer, wastewater and biomass sampling equipment, computers and laboratory space required were provided by UGA. UGA utilized ten (10) Teledyne ISCO full-size portable self contained water sampling units to accomplish all testing procedures. Six (6) units were 3700 series and four (4) units were 6712 series. Both series types are industry standard water sampling devices that provide detailed automated controls to conduct any type of automated field sampling.

All testing consumables and shipping supplies required for water sampling were provided by MPI Research Laboratory (MPI), the third party lab contracted to perform wastewater sample testing. MPI is one of only three laboratories in North America that have the capability to perform the required PFOA/PFOS testing.

Dalton Utilities personnel assisted UGA personnel in identifying the specific wastewater sampling location at each IU site prior to each week of sampling.

Sampling Process

An ISCO self contained sampling unit fitted with a single 10L Nalgene collection bottle was installed and began sampling at each IU sampling point on the Monday morning of each sampling week. All sampling was done as a composite in which 50ml aliquots were taken every 15 minutes for a 24 hour period, resulting in a total daily sample volume of 4800mL. After each 24 hour sampling period, the composite sample was thoroughly mixed and a 1000mL subsample was retained and placed on ice. After the subsample was taken, the remaining wastewater in each composite bottle was returned back to the wastewater collection system and the sampler was reset for the next 24 hour sampling period. The 24 hour composite sampling process was repeated for 5 consecutive days and concluded on Saturday morning, the fifth day.

For facilities where 24 hour composite sampling was impractical, such as force main batch discharger or facilities with abbreviated operational schedules, multiple grab samples during discharges were collected for the duration of the sampling event.

After the conclusion of each week of testing the five (5) daily 24 hour subsamples were brought back to a UGA laboratory where they were combined into a single weekly sample for each IU location. All weekly samples were shipped overnight to MPI for testing.

Throughout sampling regime, all samples were kept on ice from the time that they left the sampling unit until the time that MPI received the samples for processing. In order to maintain testing integrity, sampling equipment utilized no Teflon tubing or any Teflon based products.

After the conclusion of each week of sampling, all ISCO units and their removable stainless steel components used during that week of sampling were thoroughly washed with hot water and heat dried and all hoses and tubing were discarded and replaced with new tubing. New Nalgene 10L composite bottles were used for each Isco unit.

Phase 1: Six (6) strategically located junctions within the wastewater collection system were sampled. The selection of these locations was determined by Dalton Utilities personnel based on previous experience with the collection system. Each wastewater sample was analyzed for the full list of PFCs (Table 1). Sampling for the 6 locations took place during Week 1.

Phase 2: Upon the completion of Phase 1, forty-one (41) IU outfalls were sampled in order of geographical location starting from the north end of Dalton and progressing to the southern portion. Each weekly composite sample from each IU was analyzed for the full list of PFCs (Table 1). The IU were sampled in lots of 9 to 11 depending on the number of sampling locations at each IU (some IU had multiple sampling points which were then combined to make the IU composite sample tested by MPI). Some facilities used forced main batch discharge schedules rather than continuous gravity fed discharge which necessitated the need to perform grab samples during these intermittent discharge events. Sampling for the 41 IU was conducted in Week 2 through Week 5.

Phase 3: Samples were collected simultaneously for influent (in) and effluent (out) at each wastewater treatment facility. A dewatered sludge sample from the composting operation was taken simultaneously with the influent and effluent samples of the wastewater plants. Each water and wastewater sample was analyzed for the full list of PFCs (Table 1). The sludge sample was analyzed for the same PFC list with the exception of the fluorotelomer alcohols as the laboratory does not have the protocols for solid sampling of the FTOH.

Reporting:

Tables 2-7 display the results for locations tested during each of the six weeks of testing. All results are in parts per billion (ppb) or ng/ml. ND and NQ are defined below:

ND = Not detected – Response is below the LOD (level of detection) of 0.0125 ng/ml (ppb)

NQ = Not quantifiable – Response is between the LOD and the LOQ of 0.0250 ng/ml (ppb)

In order to ensure the quality of the laboratories analysis, a blind duplicate sample was included in each lot of samples sent to MPI. The sample that was chosen for this duplicate sample was chosen at random. In addition to duplicates, trip samples were also analyzed to ensure no contamination during the field sampling.

Site Weather Conditions

General weather conditions were noted during field sampling.

Week 1 (11/2/09 - 11/6/09)

- Daily temperatures ranged from 58F – 82F
- There was no significant rainfall at all during the week

Week 2 (11/16/09 - 11/20/09)

- Daily temperatures ranged from 34F – 62F
- There was 0.25” of cumulative rainfall during the week, primarily on Wed 11/18/09

Week 3 (11/30/09 - 12/4/09)

- Daily temperatures ranged from 33F – 52F
- There was 1.75” of cumulative rainfall and 0.25” of snowfall during the week. Rainfall events were on Wed 12/02/09 and Fri 12/04/10 and snow on Sat 12/05/09

Week 4 (12/14/09 - 12/18/09)

- Daily temperatures ranged from 24F – 42F
- There was 2.65” of cumulative rainfall on two days, Fri 12/18/09 and Sat 12/19/09

Week 5 (1/11/10 - 1/15/10)

- Daily temperatures ranged from 23F – 34F
- Extended freezing temperatures did result in some freezing of hose tubes in sampling units
- There was no significant rainfall at all during the week

Week 6 (2/1/10 - 2/5/10)

- Daily temperatures ranged from 33F – 40F
- There was 1.0” of cumulative rainfall on Thurs 02/04/10 and Fri 02/05/10

Table 1 List of tested compounds

Compound	Acronym
Perfluorobutanoic acid	C4
Perfluoropentanoic acid	C5
Perfluorohexanoic acid	C6
Perfluoroheptanoic acid	C7
Perfluorooctanoic acid	C8
Perfluorononanoic acid	C9
Perfluorodecanoic acid	C10
Perfluoroundecanoic acid	C11
Perfluorododecanoic acid	C12
Perfluorotridecanoic acid	C13
Perfluorotetradecanoic acid	C14
Perfluorobutane sulfonate	PFBS
Perfluorohexane sulfonate	PFHxS
Perfluorooctane sulfonate	PFOS
Perfluorooctane sulfonamide	PFOSA
Perfluoroheptane sulfonate	PFHpS
Perfluorodecane sulfonate	PFDS
2(N-methylperfluorooctanesulfonamido) acetic acid	MeFOSAA
2(N-ethylperfluorooctanesulfonamido) acetic acid	EtFOSAA
N-methylperfluorooctanesulfonamidoethanol	N-MeFOSE
N-ethylperfluorooctanesulfonamidoethanol	N-EtFOSE
7:2 sFluorotelomer alcohol	7:2 sFTOH
6:2 Fluorotelomer alcohol	6:2 FTOH
8:2 Fluorotelomer alcohol	8:2 FTOH
10:2 Fluorotelomer alcohol	10:2 FTOH

Table 2 Week 1 Lab Results

Location ID	C4 - PFBA (ppb)	C5 PFPA (ppb)	C6 PFHxA (ppb)	C7 PFHpA (ppb)	C8 PFOA (ppb)	C9 PFNA (ppb)	C10 PFDA (ppb)	C11 PFUnA (ppb)	C12 PFDoA (ppb)	C13 PFTA (ppb)	C14 PFTeA (ppb)	PFBS (ppb)
1	ND	ND	0.0657	0.0301	0.0776	NQ	ND	ND	ND	ND	ND	0.0606
2	NQ	NQ	0.0659	NQ	0.0720	0.0674	ND	ND	ND	ND	ND	0.0825
3	ND	ND	NQ	NQ	0.0709	ND	ND	ND	ND	ND	ND	0.103
4	NQ	0.0384	0.0543	0.0358	0.0763	0.0403	NQ	ND	ND	ND	ND	0.0388
5	NQ	0.0331	0.0622	0.0634	0.133	0.0543	NQ	ND	ND	ND	ND	0.0897
6	ND	0.0536	0.0768	0.0485	0.169	0.106	ND	ND	ND	ND	ND	0.0267

Location ID	PFHS (ppb)	PFOS (ppb)	FOSA (ppb)	PFHpS (ppb)	PFDS (ppb)	MeFOSAA (ppb)	EtFOSAA (ppb)	MeFOSE (ppb)	7-2s FTOH (ppb)	6-2 FTOH (ppb)	8-2 FTOH (ppb)	10-2 FTOH (ppb)
1	0.0851	0.52	ND	ND	ND	NQ	ND	0.0773	ND	ND	ND	ND
2	0.0269	0.792	ND	ND	ND	NQ	ND	0.937	ND	ND	ND	ND
3	NQ	0.0747	ND	ND	ND	ND	0.0282	0.25	ND	ND	ND	ND
4	ND	2	ND	ND	ND	NQ	ND	0.0639	ND	1.1	ND	ND
5	ND	1.74	ND	ND	ND	0.042	ND	0.554	ND	ND	ND	ND
6	NQ	0.686	ND	ND	ND	NQ	ND	NQ	ND	3.3	ND	ND

Table 3 Week 2 Lab Results

Location ID	C4 - PFBA (ppb)	C5 PFPA (ppb)	C6 PFHxA (ppb)	C7 PFHpA (ppb)	C8 PFOA (ppb)	C9 PFNA (ppb)	C10 PFDA (ppb)	C11 PFUnA (ppb)	C12 PFDoA (ppb)	C13 PFTA (ppb)	C14 PFTeA (ppb)	PFBS (ppb)
7	ND	ND	ND	0.0285	0.0514	NQ	NQ	ND	NQ	ND	NQ	0.0323
8	0.048	NQ	ND	ND	0.0631	NQ	ND	ND	ND	ND	ND	0.243
9	ND	NQ	ND	ND	NQ	ND	ND	ND	ND	ND	ND	0.0513
10	NQ	0.0513	0.0933	0.036	0.0793	0.0377	NQ	ND	ND	ND	ND	0.0273
11	ND	ND	ND	NQ	0.0289	0.0931	ND	ND	ND	ND	ND	NQ
12	ND	ND	ND	NQ	0.0252	ND	ND	ND	ND	ND	ND	0.0398
13	NQ	ND	NQ	NQ	0.0336	ND	ND	ND	ND	ND	ND	0.0927
14	ND	ND	ND	NQ	NQ	0.211	ND	ND	ND	ND	ND	ND
15	NQ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NQ

Location ID	PFHS (ppb)	PFOS (ppb)	FOSA (ppb)	PFHpS (ppb)	PFDS (ppb)	MeFOSAA (ppb)	EtFOSAA (ppb)	MeFOSE (ppb)	7-2s FTOH (ppb)	6-2 FTOH (ppb)	8-2 FTOH (ppb)	10-2 FTOH (ppb)
7	ND	0.0329	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	0.0305	0.0649	ND	ND	ND	NQ	ND	1.02	ND	ND	ND	ND
9	ND	11.1	ND	ND	ND	NQ	ND	NQ	ND	ND	ND	ND
10	ND	2.1	ND	ND	ND	0.0529	ND	ND	ND	4.6	ND	ND
11	0.136	4.33	ND	ND	ND	NQ	ND	0.0347	ND	ND	ND	ND
12	ND	NQ	ND	ND	NQ	ND	ND	ND	ND	ND	ND	ND
13	ND	0.0795	ND	ND	ND	ND	ND	NQ	ND	ND	ND	ND
14	1.87	3.78	ND	ND	ND	ND	ND	0.0679	ND	ND	ND	ND
15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 4 Week 3 Lab Results

Location ID	C4 - PFBA (ppb)	C5 PFPA (ppb)	C6 PFHxA (ppb)	C7 PFHpA (ppb)	C8 PFOA (ppb)	C9 PFNA (ppb)	C10 PFDA (ppb)	C11 PFUnA (ppb)	C12 PFDoA (ppb)	C13 PFTA (ppb)	C14 PFTeA (ppb)	PFBS (ppb)
16	NQ	0.102	0.238	0.0289	0.032	ND	0.0255	ND	ND	ND	ND	ND
17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NQ
19	NQ	0.0305	0.207	0.0267	0.101	0.144	0.0452	ND	ND	ND	ND	ND
20	NQ	0.0784	0.159	0.0938	0.277	0.0451	0.0594	ND	ND	ND	ND	ND
21	NQ	0.0394	0.0696	NQ	0.0389	ND	ND	ND	ND	ND	ND	NQ
22	NQ	NQ	ND	ND	0.137	ND	ND	ND	ND	ND	ND	0.0347
23	ND	NQ	0.0296	0.047	0.09	0.0368	ND	NQ	ND	ND	ND	ND
24	ND	ND	ND	ND	0.0258	ND	ND	ND	ND	ND	ND	ND

Location ID	PFHS (ppb)	PFOS (ppb)	FOSA (ppb)	PFHpS (ppb)	PFDS (ppb)	MeFOSAA (ppb)	EtFOSAA (ppb)	MeFOSE (ppb)	7-2s FTOH (ppb)	6-2 FTOH (ppb)	8-2 FTOH (ppb)	10-2 FTOH (ppb)
16	ND	0.162	ND	ND	ND	ND	ND	ND	ND	3.4	ND	ND
17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	0.035	7.43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
19	ND	0.0404	ND	ND	ND	ND	NQ	0.0462	ND	ND	ND	ND
20	ND	0.107	ND	ND	ND	0.146	ND	0.0555	ND	1.4	ND	ND
21	ND	0.233	ND	ND	ND	ND	ND	ND	ND	2.6	ND	ND
22	ND	1.9	ND	ND	ND	ND	ND	0.348	ND	ND	ND	ND
23	ND	1.81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24	ND	0.0618	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 5 Week 4 Lab Results

Location ID	C4 - PFBA (ppb)	C5 PFPA (ppb)	C6 PFHxA (ppb)	C7 PFHpA (ppb)	C8 PFOA (ppb)	C9 PFNA (ppb)	C10 PFDA (ppb)	C11 PFUnA (ppb)	C12 PFDoA (ppb)	C13 PFTA (ppb)	C14 PFTeA (ppb)	PFBS (ppb)
25	ND	0.181	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
26	ND	0.0483	0.076	0.037	0.142	NQ	0.0323	ND	ND	ND	ND	0.645
27	ND	0.0528	0.0598	0.0532	0.134	0.0531	NQ	ND	ND	ND	ND	0.0486
28	ND	0.0438	0.0604	0.0582	0.124	0.163	0.0365	NQ	ND	ND	ND	ND
29	ND	ND	NQ	ND	0.0445	ND	ND	ND	ND	ND	ND	0.0569
30	ND	0.16	0.13	0.0987	0.294	0.0454	0.0679	NQ	ND	ND	ND	NQ
31	ND	ND	ND	ND	ND	0.0391	ND	ND	ND	ND	ND	ND
32	ND	NQ	ND	ND	ND	0.0367	ND	ND	ND	ND	ND	ND
33	ND	ND	NQ	ND	NQ	ND	ND	ND	ND	ND	ND	ND
34	ND	ND	0.0478	NQ	0.0461	ND	ND	ND	ND	ND	ND	ND
35	ND	ND	0.0529	0.0533	0.0635	0.0256	ND	ND	ND	ND	ND	ND

Location ID	PFHS (ppb)	PFOS (ppb)	FOSA (ppb)	PFHpS (ppb)	PFDS (ppb)	MeFOSAA (ppb)	EtFOSAA (ppb)	MeFOSE (ppb)	7-2s FTOH (ppb)	6-2 FTOH (ppb)	8-2 FTOH (ppb)	10-2 FTOH (ppb)
25	ND	ND	ND	ND	ND	ND	ND	2.6	ND	ND	ND	ND
26	ND	0.538	0.043	ND	ND	0.0686	0.046	3.65	ND	ND	ND	ND
27	ND	1.18	ND	ND	ND	0.123	ND	0.137	ND	ND	ND	ND
28	ND	24.2	ND	ND	ND	0.0301	ND	ND	ND	ND	1.4	ND
29	ND	0.234	ND	ND	0.0563	ND	ND	0.124	ND	1.4	ND	ND
30	ND	1.13	0.0387	ND	ND	0.342	0.0677	0.0401	ND	2	ND	ND
31	ND	ND	ND	ND	ND	ND	ND	0.573	ND	ND	ND	ND
32	ND	5.99	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
33	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 6 Week 5 Lab Results

Location ID	C4 - PFBA (ppb)	C5 PFPA (ppb)	C6 PFHxA (ppb)	C7 PFHpA (ppb)	C8 PFOA (ppb)	C9 PFNA (ppb)	C10 PFDA (ppb)	C11 PFUnA (ppb)	C12 PFDoA (ppb)	C13 PFTA (ppb)	C14 PFTeA (ppb)	PFBS (ppb)
36	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37	ND	NQ	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0308
38	ND	0.0311	NQ	NQ	0.0703	ND	ND	ND	ND	ND	ND	NQ
39	ND	0.0265	ND	ND	0.0495	ND	ND	ND	ND	ND	ND	ND
40	ND	ND	ND	ND	NQ	0.0266	ND	ND	ND	ND	ND	ND
41	ND	ND	ND	ND	0.0266	0.0765	ND	ND	ND	ND	ND	ND
42	ND	0.0412	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
44	ND	ND	NQ	ND	0.0791	0.0631	ND	ND	ND	ND	ND	0.053
45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0357
46	ND	ND	0.0256	ND	0.128	ND	0.0306	ND	ND	ND	ND	ND

Location ID	PFHS (ppb)	PFOS (ppb)	FOSA (ppb)	PFHpS (ppb)	PFDS (ppb)	MeFOSAA (ppb)	EtFOSAA (ppb)	MeFOSE (ppb)	7-2s FTOH (ppb)	6-2 FTOH (ppb)	8-2 FTOH (ppb)	10-2 FTOH (ppb)
36	ND	2.56	ND	ND	ND	ND	ND	ND	ND	ND	1.7	ND
37	ND	4.17	ND	ND	ND	ND	ND	0.0321	ND	ND	ND	ND
38	ND	0.0574	ND	ND	ND	0.0267	ND	ND	ND	ND	ND	ND
39	ND	0.0284	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND
40	ND	0.63	ND	ND	ND	ND	ND	ND	ND	6.3	ND	ND
41	ND	1.26	ND	ND	ND	ND	ND	ND	ND	6.6	ND	ND
42	ND	0.316	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
44	0.0942	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
45	ND	0.026	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
46	ND	ND	ND	ND	ND	ND	ND	0.137	ND	ND	1.4	ND

Table 7 Week 6 Lab Results

Location ID	C4 - PFBA (ppb)	C5 PFPA (ppb)	C6 PFHxA (ppb)	C7 PFHpA (ppb)	C8 PFOA (ppb)	C9 PFNA (ppb)	C10 PFDA (ppb)	C11 PFUnA (ppb)	C12 PFDoA (ppb)	C13 PFTA (ppb)	C14 PFTeA (ppb)	PFBS (ppb)
47	ND	0.0731	0.104	0.0599	0.227	0.0388	NQ	ND	ND	ND	ND	0.0981
48	0.0645	0.465	0.351	0.12	0.221	0.0288	0.0323	ND	ND	ND	ND	0.367
49	0.114	0.474	0.382	0.172	0.23	0.0253	0.0454	0.0327	ND	ND	ND	1.69
50	0.123	0.424	0.372	0.15	0.351	0.0719	0.155	0.0862	ND	ND	ND	1.56
51	0.0853	0.568	0.205	0.0993	0.321	0.0815	0.0569	0.0358	NQ	NQ	ND	2.97
52	0.48	0.677	0.405	0.193	0.422	0.165	0.25	0.111	ND	ND	ND	1.72
53	0.333	0.57	0.333	0.162	0.354	0.0579	0.101	0.048	ND	ND	ND	1.49
54	29.9	27.8	21.5	8.97	97.2	64	340	411	113	177	22.3	623

Location ID	PFHS (ppb)	PFOS (ppb)	FOSA (ppb)	PFHpS (ppb)	PFDS (ppb)	MeFOSAA (ppb)	EtFOSAA (ppb)	MeFOSE (ppb)	7-2s FTOH (ppb)	6-2 FTOH (ppb)	8-2 FTOH (ppb)	10-2 FTOH (ppb)
47	NQ	0.104	ND	ND	ND	0.054	ND	0.272	ND	1.3	ND	ND
48	0.0251	0.11	ND	ND	ND	0.262	ND	ND	ND	ND	ND	ND
49	NQ	0.149	ND	ND	ND	0.0517	ND	0.0346	ND	ND	ND	ND
50	0.0286	0.428	ND	ND	ND	0.149	0.0281	0.0333	ND	ND	ND	ND
51	NQ	0.155	ND	ND	ND	0.0612	ND	0.253	ND	1.4	ND	ND
52	NQ	0.186	ND	ND	ND	0.292	0.0302	ND	ND	ND	ND	ND
53	NQ	0.222	ND	ND	ND	0.274	0.0356	ND	ND	ND	ND	ND
54	1.89	219	46.3	2.11	1.9	72.9	31.3	56.6	NQ			